# Space Weather Technical Forecast

Issued on Friday, 10 June 2022 at 13:29 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

**Space Weather Forecast Headline: Chance of further M-class flares.**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Solar activity is now at Moderate levels, with numerous C-class flares observed that have increased in frequency in recent hours and an M1-class flare observed at 10/1053 UTC. There are currently five sunspot regions on the visible disc, with the most notable regions AR3030 (Dao/Beta) and an as yet, unnumbered region (Dao/Beta) both close to the northeast limb. All other regions are simple, benign regions at this time. A CME associated with a filament eruption, tied to the C-flare from an unnumbered region near the southern central disc at 09/2200 UTC is current being modelled, though is expected to miss earth. No further CMEs have been observed in available imagery.

**Solar Wind / Geomagnetic Activity:** The solar wind, observed by DSCOVR at L1 has been at ambient levels, currently averaging around 300km/s. Density has been predominantly just above average, though was at average levels between 10/0400-0930 UTC. Total interplanetary magnetic field strength has been largely weak, but increased to Moderate levels (peaking at just over 8nT around 10/0900 UTC) for a time early in the UTC day. The north-south component, Bz, was generally weakly negative. Phi angle was mainly negative (towards the sun) until 10/1000 UTC, with an abrupt switch to the positive (away from sun) sector. This may be indicative of a Solar Sector Boundary Crossing. Geomagnetic activity was Quiet (Kp 1-2).

**Energetic Particles / Solar Radiation:** The high energy proton flux (10 MeV) has been at background levels. Electron flux (greater than 2MeV) has been predominantly at background levels, occasionally reaching Moderate levels, with a peak of 151 pfu at 09/2105 UTC. Electron fluence has been well below the Active (1e8 integrated pfu) threshold, with 1.55e6 integrated pfu recorded at 10/0000 UTC on a gently increasing trend.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Solar activity is expected to be mainly Low, with a chance of further M-class flares, mainly from the two sunspot regions close to the northeast limb. X class flare probabilities are very slightly increased due to uncertainty in the analysis of the sunspots in the far northeast Further bright regions may rotate onto the earth-facing disc in the coming days to supplement the elevated flare risk.

**Solar Wind / Geomagnetic Activity:** No Earth-directed CMEs are currently forecast. A coronal hole may connect with the Earth on Day 1 (10th), but as the feature is very small and weak, only slightly elevated winds are predicted. Geomagnetic activity is forecast to be mainly Quiet (Kp 0-2) with a chance of isolated Unsettled (Kp 3) intervals Day 1 and into early Day 2 (11th).

**Energetic Particles / Solar Radiation:** High energy proton flux (greater than 10 MeV) is expected to be at background levels during this period. High energy electron flux (greater than 2 MeV) is expected to vary between background and moderate levels. Electron fluence is expected to remain below the Active threshold throughout, with probably a slight upward trend in fluence levels during the period.

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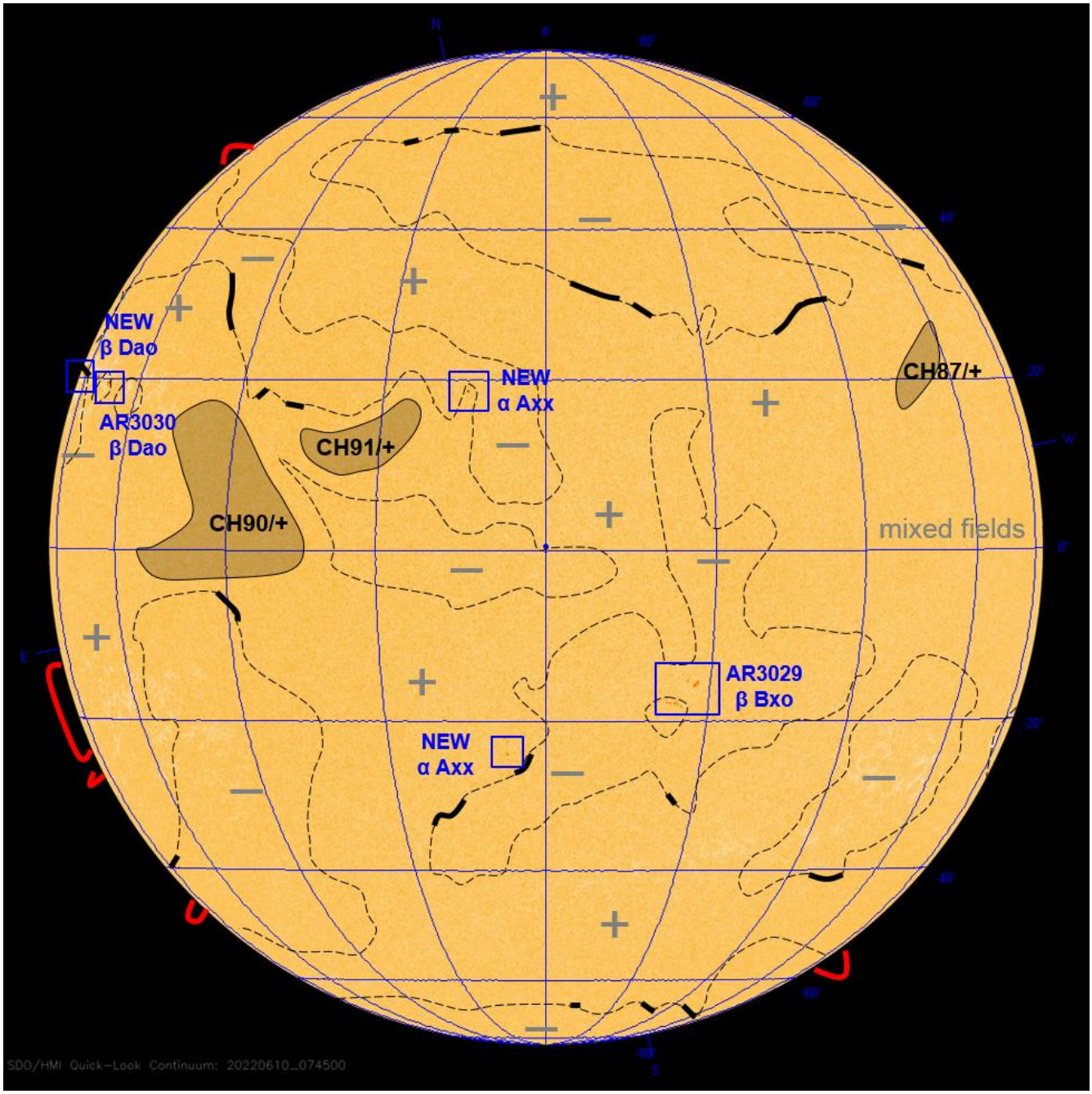
**Figure 1. Solar Analysis Valid 10/0745 UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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# Met Office Space Weather Technical Forecast

## Geomagnetic Storms:

A CME associated with a filament eruption, tied to the C-flare from an unnumbered region near the southern central disc at 09/2200 UTC is current being modelled, though is expected to miss earth. No further CMEs have been observed in available imagery.

Solar winds are expected to be at mainly background levels throughout the forecast period. There is a chance of a slight enhancement, due to a high speed stream from CH87/+, today (10 June) with speeds of up to 400-450km/s possible. However, due to the proximity of the solstice and because CH87/+ is small and weak, any resultant geomagnetic activity is expected to be muted.

Geomagnetic activity is forecast to be mainly Quiet (Kp 0-2) with a chance of isolated Unsettled (Kp 3) intervals Day 1 and into early Day 2 (11th).

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 1 | 1 | 1 | 1 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

## Geomagnetic Activity - Earthbound Coronal Mass Ejections - Nil

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## Radio Blackouts - X-Ray Flares:

Solar activity is now at Moderate levels, with numerous C-class flares that have become more frequent in recent hours and an M1-class flare observed at 10/1053 UTC from one of the two new regions in the far northeast quadrant.

There are currently five sunspot regions on the visible disc, with the most notable regions AR3030 (Dao/Beta) and an as yet, unnumbered region (Dao/Beta) both close to the northeast limb. These regions appear magnetically rather complex although analysis of these groups are hindered by the foreshortened nature of available imagery. The unnumbered group may indeed be the return of AR3014 which has been active on the past two rotations.

AR3029 in the southwest quadrant has decayed in the past 24-hours, with no clear penumbra visible on any of the numerous spots. The group is now given a Bxo/Beta configuration. The other two sunspot groups near the centre disc are simple, Axx/Alpha spots.

Solar activity is expected to be mainly Low, with a chance of further M-class flares, mainly from the two sunspot regions close to the northeast limb. X class flare probabilities are very slightly increased due to uncertainty in the analysis of the sunspots in the far northeast. Further bright regions may rotate onto the earth-facing disc in the coming days to supplement the elevated flare risk.

| X Ray Flares<br>Probability | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| Active | R1-R2 M Class | No | 20 | 20 | 20 | 20 |
| Very Active | R3 to R5 X Class | No | 3 | 3 | 3 | 3 |

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**Figure 2: GOES16/17 X-ray flux observations.**

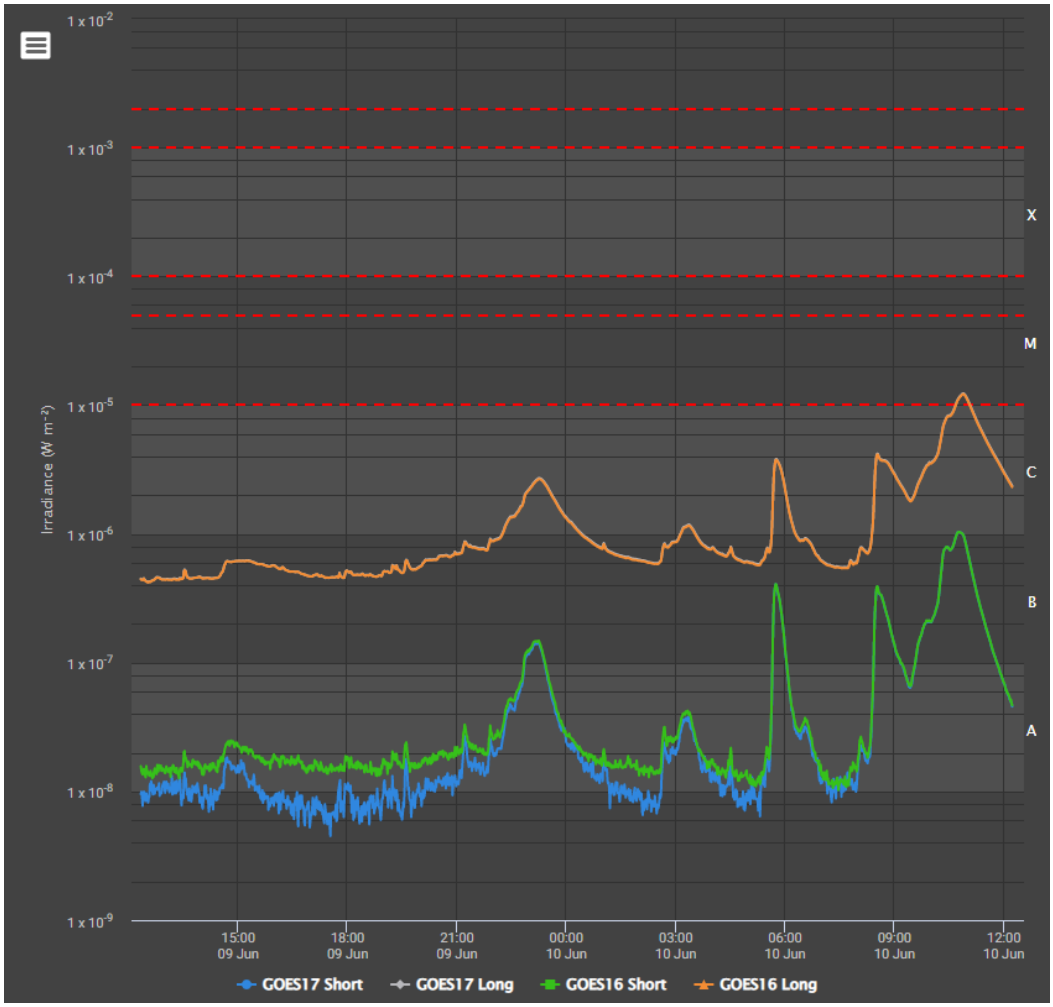
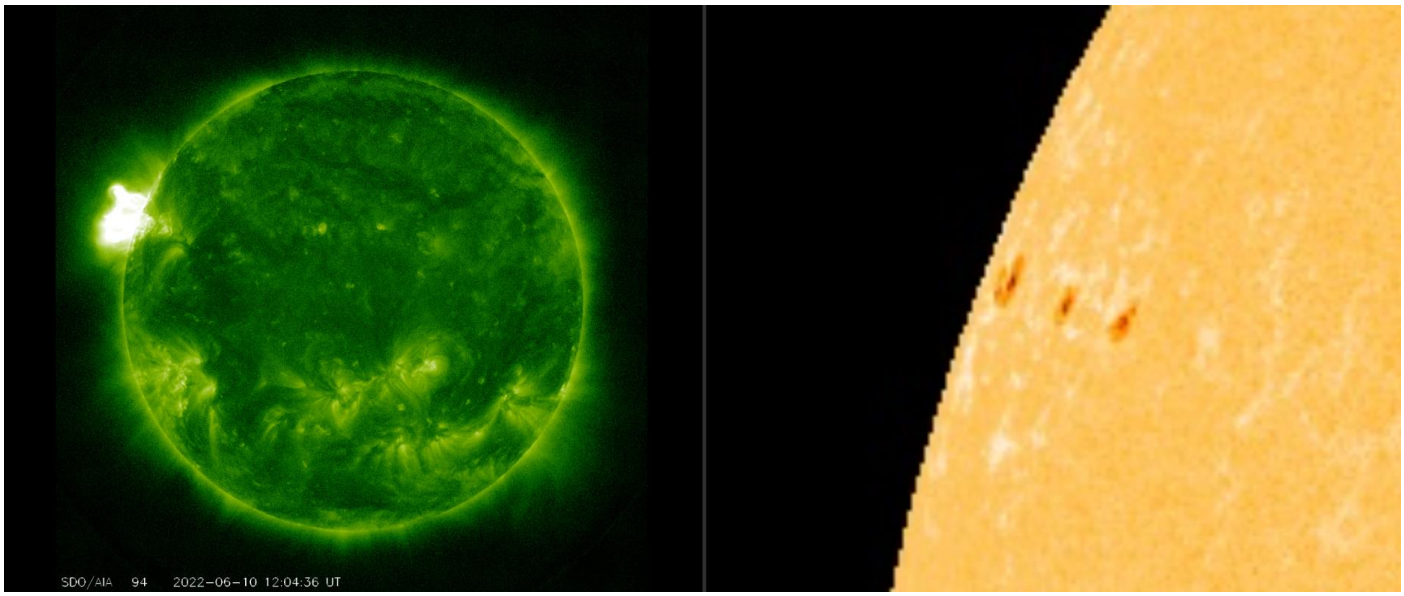



**Figure 3: SDO/AIA 94 imagery 10/1204 UTC (left) and two emerging sunspot regions over the NE limb (right).**

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## Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels. It is expected to remain at this level through the period in the absence of significant sunspot regions in the western hemisphere.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 1 | 1 | 1 | 1 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

## High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to remain at mainly background to moderate levels through the next four days. There may be a slightly rising trend in the diurnal peak during the period should the Earth connect with the weak CH87/+.

Corresponding electron fluence values are also expected to remain below the Active (1e8 integrated pfu) throughout, with a steady or possibly gently increasing trend.

The Met Office REFM model supports the fluence remaining well below the Active threshold through the period.

| GEO Electron Environment Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ 2 MeV ≥ $1x10^8$** | No | 1 | 1 | 3 | 5 |
| **Very Active** | **≥ 2 MeV ≥ $1x10^9$** | No | 1 | 1 | 1 | 1 |

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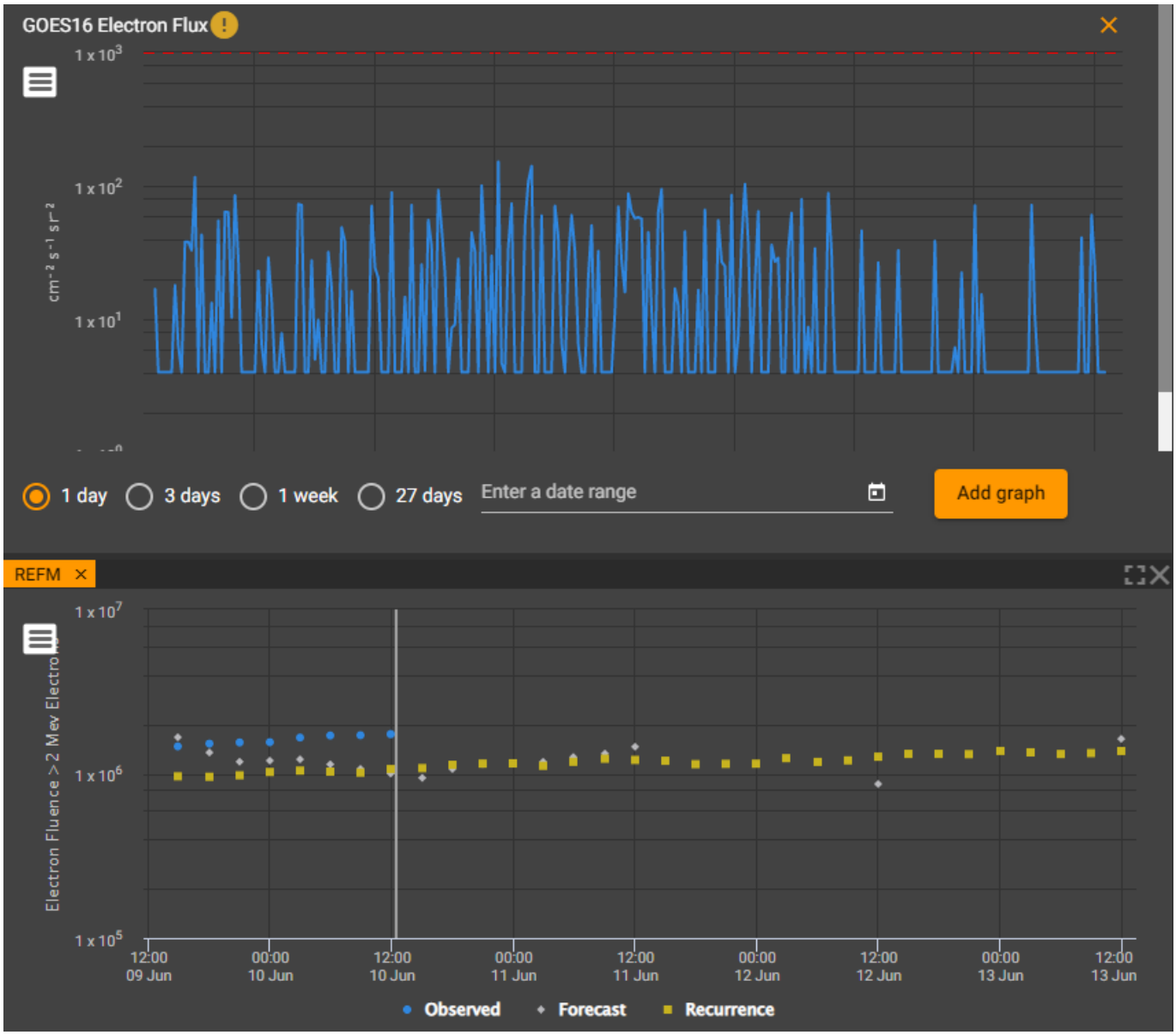
**Figure 4: GOES-16 electron flux (top) and MOSWOC REFM model (below)**

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